Human and robotic hands

Prof.ssa Monica Malvezzi

Abstract

"*The hand is the tool of tools*" (Aristotle): hands represent the main interface that humans use to perceive and act on their surrounding environment. The availability of such fundamental action and perception tools is sometimes compromised. Hand abilities are subjective characteristics, usually decrease with age and could be affected by several acute or chronic diseases that could limit their ability in objects' gripping and manipulation and in tactile perception. Rehabilitation has the objective of maintaining or recovering the physical abilities of the patient, encouraging, at least partially, the recovery of lost functionality and enabling the patient's autonomy. Traditional therapies can improve functional recovery, but are expensive, often based on qualitative estimations rather than quantitative evaluations and must be held in one-to-one physiotherapist/patient in-person meetings. On the other hand, technology plays an important role for people with disabilities or affected by chronic or temporary diseases. In particular, the use of robotic devices in rehabilitation can be beneficial, as it requires a less workforce, and allows a more lasting and more intense therapy. However, due to hand biomechanical, sensing and control complexity, notwithstanding the interesting and potentially useful technological advancements, a comprehensive wearable system for hand theranostics is still lacking.

In our research we start from the study of hand basic grasping and manipulation functions and use the results from this analysis to design and develop versatile and adaptable robotic grippers and wearable robotic devices for haptics and non-invasive hand therapy, exploiting soft robotics concepts and soft materials, to obtain devices inherently safe and adaptable to user's specific data and needs.

Bio sketch

Monica Malvezzi is Associate Professor of Mechanics and Mechanism Theory at the Dept. of Information Engineering and Mathematics of the University of Siena. From 2015 to 2019 she was also visiting scientist at the Dept. of Advanced Robotics, Istituto Italiano di Tecnologia, Genova, Italy. From 2003 to 2007 she was a researcher at the Energy Engineering Department of the University of Firenze. She received the Laurea degree in Mechanical Engineering from the University of Florence in 1999 and the Ph.D. degree in Applied Mechanics from the University of Bologna in 2003. Her main research interests are in control of mechanical systems, robotics, vehicle localization, multibody dynamics, haptics, grasping and dexterous manipulation.

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